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ABSTRACT

The Program on Science, Technology and Society (POSTS), directed toward understanding a technologically dependent civilization, aims to illuminate the interrelation of technology and culture by means of more effective communication between specialists in the natural, behavioral, and policy studies. This report contains short, substantive descriptions of research projects undertaken by fellows of the program between May 1971 and August 1973 as well as a list of the recent publications and presentations. (Authors)

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First General Report

POSTS

PROGRAM ON SCIENCE, TECHNOLOGY & SOCIETY

Center for Advanced Study in the Behavioral Sciences

May 1, 1971 through August 31, 1972

SE020 790

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Prepared by Paul Armer
and Pamela Gullard

5/1/74

202 Junipero Serra Boulevard, Stanford, California 94305,
Telephone (415) 321-2052

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IV. CENTER FOR ADVANCED STUDY IN THE BEHAVIORAL SCIENCES

The Center is a non-profit organization established by the Ford Foundation in 1954. It is located on a secluded hilltop near Stanford University in California. It conducts a fellowship program for distinguished scholars in fields that illuminate the question of how men and societies behave, or are in disciplines which are enough allied to the behavioral sciences that the presence of the scholar adds to the environment for all the Fellows. Each year about fifty scholars participate, working at the Center for the academic year.

The intent of the Center is to improve the quality of the participating scholar. To accomplish this, it provides him with the time and facilities to intensely pursue and develop his intellectual interests without interruption, to reevaluate himself in relation to his field, and to closely interact with peers from various fields. For the year he is freed from the teaching and administrative chores he carries at his home institution. The Center focuses on maintaining an environment which allows for reflective study yet promotes conversation and interaction among the scholars. In this atmosphere, the scholar not only can increase his knowledge, but can also bring to his work different perspectives gained from the other Fellows. Many Fellows have found that this freshening experience continues to influence their work, and consequently that of their colleagues, years after the fellowship has ended. The accumulated writings and the changed perspective of the approximately 1000 scholars who have spent a year at the Center are the fruit of the original idea for the Center.

Because the Center's major interest is in scholar building, selection of a Fellow is based on his past performance and on his promise as a productive scholar. His demonstrated or potential leadership abilities are more important than the nature of his particular interests. Nevertheless, each Fellow is chosen for his possible contribution to the year's particular scholar group. The Center's selection process is geared to create each year a synergistic scholarly community.

Though founded by the Ford Foundation and the recipient of an endowment fund and operating grants from the Ford Foundation, the Center depends on numerous sources of funds to meet its operational expenditures. Grants are made directly to the Center and some scholars arrive with outside grants or partial support through sabbatical leave arrangements with their home institutions.

V. PROGRAM ON SCIENCE, TECHNOLOGY AND SOCIETY (POSTS)

The Program on Science, Technology and Society (POSTS), directed toward understanding a technology-dependent civilization, aims

to illuminate the interrelation of technology and culture by means of more effective communication between specialists in the natural, and the behavioral and policy sciences. The focus of the program is not so much to produce problem-solving books and articles as to improve the quality of scholars concerned with the problems of today's society and to increase the awareness of these problems in scholars not now directly involved.

Problems at the interface between science, technology and society are almost always multi-disciplinary in nature. Yet our educational institutions, with very few exceptions, produce only specialists. So, to be effective in dealing with problems in the science, technology and society area, scholars often have to devote considerable effort to educating themselves in disciplines other than their original specialty. Some Fellows have utilized their year at the Center to move into these multi-disciplinary problem areas. Thus, the purpose of POSTS is in concert with the scholar building intent of the entire Center. The reflective nature which dominates most of the rest of life at the Center also dominates the POSTS program. Fellows are free to move in and out of the program as their intellectual pursuits dictate.

The products of the POSTS program include research and writing on the ramifications of today's technology (many of which are described in Section VII). But more importantly, by promoting discussions at the Center on the socio-scientific problems of our time, the program alters the perceptions and even the research interests not only of scholars directly involved in the program but also of their associates at the Center. The most important follow-on result of the POSTS program is its continuing influence on the scholar's viewpoint and, subsequently, on that of his colleagues at his home institution and in his profession. POSTS scholars frequently speak about their work before audiences ranging from their fellow professionals to the public at large, thus increasing the general knowledge and awareness of the problems of a technology-dependent society.

The scope of the POSTS program covers a wide number of complex topics, usually involving specific technologies and policies. Consequently, the POSTS program builds small groups of Fellows each year around several core topics as well as providing fellowships for individual projects. Cohorts of Fellows in a given year are assembled with an eye to maximizing interaction among them through common interests or through interdisciplinary cooperation.

The content of POSTS is determined by an Advisory Council (members listed earlier) which provides definition and review of the program and nominates and helps recruit appropriate Fellows. Paul Armer became Coordinator of POSTS in March 1972, dividing his time between that function and that of being a Fellow. The Board of Trustees of the Center has also maintained a close interest in the

program and has final authority in approving fellowships for specific individuals.

Although the awarding of the grant by N.S.F. to the Center was the specific action which brought POSTS into being, financial support for the program is diverse. Since the grant does not provide for an indirect cost allowance, Center funds (either from endowment income or other grants) are required for all Fellows participating in the program. Further, some participating Fellows have been partially supported by their home institutions and/or grants from various agencies and foundations. For example, the program's core project on race, development and performance received major support from the Office of Child Development of the Department of Health, Education and Welfare through the Social Science Research Council.

Many Fellows work on several topics while at the Center. For some of the Fellows listed in Section VI as having been associated with POSTS, only a fraction of their activities was POSTS-related. In such cases their support from the Center was charged to POSTS on a corresponding basis.

VI. FELLOWS ASSOCIATED WITH POSTS

1971/1972

Charles O. Jones
University of Pittsburgh, Maurice Falk Professor of Politics

Joshua Lederberg
Stanford University, School of Medicine, Professor of Genetics and Scientist in Residence at the Center for Advanced Study in the Behavioral Sciences, POSTS program

Gardner Lindzey
University of Texas, Vice President and Dean of Graduate Studies

James C. Loehlin
University of Texas, Professor of Psychology

Edwin Mansfield
Wharton School, University of Pennsylvania, Professor of Economics

James N. Spuhler
University of New Mexico, Leslie Spier Professor of Anthropology

1972/1973

Paul Armer
Center for Advanced Study in the Behavioral Sciences, Coordinator of the POSTS program and Fellow

William F. Baxter
Stanford University, Professor of Law

John S. Chipman
University of Minnesota, Professor of Economics

Victor R. Fuchs
City University of New York, Professor of Economics and National Bureau of Economic Research, Inc., Vice President—Research

Donald Kennedy
Stanford University, Professor of Biology

Joshua Lederberg
Stanford University, School of Medicine, Professor of Genetics and Scientist in Residence at the Center for Advanced Study in the Behavioral Sciences, POSTS program

John R. Platt
Mental Health Research Institute, Associate Director and University of Michigan, Professor of Physics

Fredrick C. Redlich
Yale University, Professor of Psychiatry

Terrance Sandalow
University of Michigan, Professor of Law

Israel Scheffler
Harvard University, Professor of Philosophy

Vernon L. Smith
University of Massachusetts, Amherst, Professor of Economics

Lefton S. Stavrianos
Northwestern University, Professor of History

Joseph Weizenbaum
Massachusetts Institute of Technology, Professor of Computer Science

VII. POSTS PROJECTS

The following is a review of the written materials and other products which have thus far resulted from POSTS. They are grouped by year and, when appropriate, under core project headings:

1971/1972*

Gardner Lindzey, John C. Loehlin, James Spuhler—*Race, Development and Performance: A Re-analysis*

Early in the history of POSTS**, the role of psychological testing in our society was identified as a problem worthy of concern. The Center sought to find a technology which had actually emerged from the social or behavioral sciences and which had had an important

*Because of the long lead times in bringing Fellows to the Center the size of the POSTS effort in general in 1971/1972 was minimal.

**In fact, the project had been identified prior to the actual awarding of the N.S.F. grant for POSTS. Because of the uncertainty of N.S.F. funding, alternative partial support was solicited and obtained from the Office of Child Development (H.E.W.) through the Social Science Research Council. Thus, both O.C.D. and N.S.F. funds supported the research effort. In addition, both Lindzey and Loehlin received partial support from the University of Texas.

impact on our society, in order that our first inquiry under the POSTS effort would respect the background of the Center as well as the concerns of the new program. Intelligence tests, personality and aptitude tests are among the more obvious technological contributions of the behavioral sciences. For years, such tests have been used to guide individual students, and have been used as a means of selection and elimination in establishing the populations of schools and professional colleges. A great deal of social reliance on those tests has developed. Because minority groups in the United States tend to receive lower average scores on them than the white population does, considerable resentment against the use of I.Q. tests has arisen. They have been challenged as "culture bound" and as devices to permit discrimination in the name of science. In fact, resentment has grown to such an extent that some scholars are reluctant to undertake study in the field of tests and measurements for fear of being called racist. Others have claimed that public policy ignores between-group differences.

The study group consisted of Gardner Lindzey, John C. Loehlin and James Spuhler, who recruited an advisory board of eminent scholars and educators to aid and advise them in their efforts. The group began by concentrating on decidable questions and the evidence that bears upon them, emphasizing this approach rather than the use of polemics. They asked the questions: *Could* some or all of the genes that affect general intelligence be differently distributed in different U.S. racial ethnic groups? If so, *are* they?

To arrive at some answers to these questions, they reviewed a number of bodies of possibly relevant evidence. From this study they concluded that:

1. Observed average differences in the scores of members of different U.S. racial-ethnic groups on intellectual ability tests probably reflect in part inadequacies and biases in the tests themselves, in part differences in environmental conditions among the groups, and in part genetic differences among the groups.

2. A rather wide range of positions concerning the relative weight to be given these three factors can be taken reasonably on the basis of current evidence, and a sensible person's position might well differ for different abilities, for different groups, and for different tests.

3. Regardless of the position taken on the relative importance of those three factors, it seems clear that the differences among individuals within racial-ethnic (and socioeconomic) groups greatly exceed the average differences between such groups.

The present state of scientific evidence does not justify stronger conclusions than those above. Further evidence should be sought in order to narrow the range of positions that an intellectually honest person may take on this issue. The study group outlined several promising areas of research to help accomplish this, including:

1. *Studies causally linking abilities to specific genes or specific environmental conditions.* If one were able to identify *particular* genes and environmental factors and their respective contributions to the variance of the trait, one could examine directly whether those genes or environmental factors differed between groups.

2. *Studies which compare several racial-ethnic groups on a number of ability measures.* A varying pattern of ability differences over a set of racial-ethnic groups is much more constraining of possible explanatory hypotheses than is comparison of two groups on a single ability measure. Few environmental conditions, for example, are likely to vary in just the fashion among the groups that would fit the pattern of observed differences.

3. *Developmental studies, especially in the first three years of life.* This is the period in which the primary differentiation of abilities takes place, so it is highly relevant to study the environmental and biological factors operating at this time. Follow-on studies of the pattern of changes of abilities over time would also be extremely useful.

4. *Cross-racial adoptions.* Such studies would offer the hope of partially disentangling genetic from family environmental factors though they would be handicapped by the fact that placements of this kind involve a highly selected subset of homes and occur almost exclusively in one direction.

5. *Racial mixture studies in the U.S.* Such studies should ideally use either good genealogical evaluation of racial mixture, or empirical evaluation using blood-group and protein markers. A multivariate study, in which changes in the ability profile are examined across varying degrees of racial admixture, should also provide powerful inferential possibilities.

6. *Educational, nutritional and other environmental manipulations.* There is tremendous research potential inherent in the introduction of environmental changes which are undertaken primarily for reasons other than research. The effects of a change in educational practices, for example, can be evaluated both within and across racial-ethnic groups.

Based on the available evidence, the group offers the following propositions for the consideration of social scientists, policy makers and concerned citizens:

1. Humane and enlightened public policy measures need not be, and should not be, constrained by either hereditarian or environmentalist dogmas.

2. Any public policy should be responsive to the fact that individual variations within U.S. racial-ethnic groups greatly exceed average between-group differences. The empirical fact that many mem-

bers of any U.S. racial-ethnic group exceed in intellectual performance the typical member of any other group is in itself a compelling case against racism.

3. "I.Q. is not everything—not nearly everything." There are many other relevant individual differences that combine to be of tremendous value.

The researchers believe that the lack of a definitive answer to the questions with which they began is neither disastrous nor disappointing. Moral and political questions never have had purely scientific answers. The factual questions involved, if phrased in limited and specific form, should indeed be answerable, and it is probably worth society's time and money to answer some or many of them. The group is fundamentally convinced that "on the whole, in any area, better and wiser decisions are made with knowledge than without."

The results of the study will be published in a forthcoming book.

Charles O. Jones

While at the Center, Jones wrote up many of the results of a large-scale study on air pollution decision-making supported in part by the Allegheny Foundation (through the Ben Arneson Institute of Politics, Ohio Wesleyan University, Dr. Arthur Peterson, Director) and the research funds of the Maurice Falk Professorship of Politics, University of Pittsburgh. Jones was partially supported with funds from E.I. DuPont DeNemours & Company while at the Center.

Jones concluded that policy-making concerning air pollution has differed from the usual policy-making process. The traditional model for policy formulation is one of majority or consensus building resulting in "disjointed incrementalism" in which the decisions made effect small or incremental changes and are not based on a high level of understanding. In the case of air pollution control, however, public support rose so dramatically in 1970 that legislators were pressured into devising strict regulations. Rather than having to find a coalition for a policy, it was necessary to find a policy for a coalition.

Air pollution is technically a very complex issue. When legislators became suddenly concerned in 1970 with its regulation, they lacked the expertise necessary for implementation of appropriate controls. Also, in Jones' opinion, the national pollution control agency was organizationally weak, lacked resources and did not have strong direction. In view of these factors, Jones terms the air pollution policy-making in the 1970's "speculative augmentation." Policy developers gambled that know-how and capabilities would catch up with policy. Jones recommends that if ". . . (speculative augmentation) is to become more common we surely need to inquire into the means for rapidly increasing technical and administrative capabilities, measur-

ing public priorities among conflicting values, and maintaining citizen support for the difficult and demanding administrative decisions necessary to implement strong regulatory policies."

Jones published three articles (6,7,8) on air pollution and contemporary environmental politics, public support and governmental regulation agencies, and on the literature of air pollution control politics. He also wrote a book, *Clean Air: The Politics and Policies of Pollution Control*, which is scheduled for publication in the fall 1974, and completed four more articles yet to be published.

Joshua Lederberg*

Although Lederberg is Scientist in Residence for POSTS, he is principally committed to the Stanford University Medical School where he receives most of his support. Included among his many interests is a concern for the social and political effects of advances in the field of biology. Two of his published articles deal with this subject, (9) and (12).

Advances in molecular biology promise to enlarge our technical capacity to intervene in genetic problems. Social and ethical factors are likely to play an increasingly important role in determining the application of new scientific advances to humans. Lederberg believes that the evolution of wise policies for the use of genetic advances requires a widely disseminated understanding of the probable potentialities of various types of genetic intervention and their technical as well as ethical limitations. In addition, the costs of enforcing constraints against such interventions must be weighed against the social motives for possible sanctions against them. Currently, such intervention generally takes the form of prenatal diagnosis coupled with elective abortion of the threatened fetus. However, cell and organ transplantation and virogenic therapy are being developed. The renucleation of eggs (cloning) is a theoretical possibility, likely in the near future to be of more metaphorical than pragmatic interest. The discussion of cloning may help to illuminate the ethical problem of parenthood, i.e. what is the responsibility of each generation for the biological and educational predetermination of its successors?

To answer such questions, it is important not only to disseminate information on genetic possibilities but also to integrate biology with the social sciences, such as psychology, philosophy and history. Such an interdisciplinary field is called "human biology." It includes many questions presently not understood, such as: When does life begin? To what extent do biological factors determine temperament, language skills, intelligence and other behavorial traits? When more intricate methods of intervention in human development are found, they must

*Includes 1971 - 1973.

be given the most careful scrutiny with respect to the social utility of their adoption. The study of "human biology" is needed to do this.

Lederberg also wrote an article on chemical and biological weapons (10). In it he outlines the history of national and international policies directing the production and use of these weapons. For example, he describes the Biological Draft Treaty (BW-71) which states that each party promises to "never . . . develop, produce, stockpile . . ." biological weapons. There are two main problems with this: the treaty does not mention actual *use* of such weapons; and the peaceful uses of potential biological weapons make verification of adherence to the treaty extremely difficult. Despite these difficulties, BW-71 and other international agreements involving chemical and biological weapons have been practical forces to deflate the pressures for such a weapons race by the superpowers. Lederberg states, "Insofar as the superpowers place some utility on the pattern of stability achieved by BW-71, they may discourage violations even in the face of local advantages to one of their allies."

In another article (11), Lederberg outlines several approaches for better directing scientific research toward improving the human condition:

a) Liberate the universities from some of the programmatic restraints of centrally administered governmental funding.
b) Promote a flourishing, well-informed and effectively critical scientific community.
c) Subject the scientist turned consultant to public scientific skepticism.
d) Provide Congress with greater access to good technical advice.
e) Assess not only individual projects, but also their aggregate impact.

New laws will be necessary to resolve conflicts of rights along new lines in the areas of: privacy, including computer dossiers on individuals; public education for over-specialized professionals; and environmental concerns, including the deprivation of individual rights for the general welfare. The registered non-profit advocate of consumer and environmental interests, already exemplified by public interest law firms, is a new institutional form needed to deal with these problems.

Edwin Mansfield

Externalities occur when one person's (or firm's) use of a resource imposes costs or damages on others who cannot obtain proper compensation. In a forthcoming article on pollution externalities and what can be done about them Mansfield states that private costs involved in pollution differ from social costs and, because the polluters do not pay the true cost of waste disposal, their products are

artificially cheap. Consequently, too much is produced of them. Mansfield states, "... where externalities are present, economists generally agree that it may be justifiable for the government to intervene." He then describes three possible methods of intervention:

- *Direct Regulations Governing Disposal and the Quality of the Environment* — These are presently being used and have been somewhat effective, but their establishment and enforcement require large amounts of technical information, and they are more costly for some firms to comply with than for others. Consequently, pollution reduction is not achieved at optimal efficiency.
- *Tax Credits for Firms that Introduce Pollution Control Equipment* — The problems with this are that even with new equipment it may still be cheaper to pollute. Tax credits for equipment would not encourage other control methods (such as substituting one fuel for another), and taxpayers other than polluters (or consumers of their products) would be paying for the new equipment.
- *Taxes or Effluents* — This is the cheapest way to achieve pollution reduction since the polluter will find it profitable to reduce his discharge of waste to the point where the cost of reducing an additional unit of waste is equal to the effluent fee. Also, less technical information is needed to administer an effluent tax than to directly regulate pollution.

Mansfield points out that if pollution is dramatically reduced it will force out of business those firms which must pollute to compete, thereby increasing unemployment. It may also increase the cost of needed goods and services more for the poor than for the rich. Mansfield suggests government intervention to transfer income to the poor to offset this effect of pollution control.

Mansfield also continued at the Center his study of the production and application of new industrial technology which was supported by grants to him from the Ford Foundation and the Small Business Administration as well as from N.S.F. and the POSTS program. Mansfield's colleagues in this project were J. Rapoport, J. Schnee, S. Wagner, and M. Hamburger. They and Mansfield have written a book, *Research and Innovation in the Modern Corporation*, W. W. Norton, which will be published soon.

In developing a model of research and development, Mansfield found that the technical risks of most R&D being conducted are relatively small. The size and complexity of the product, the available stock of knowledge, the components and materials and the development strategy used all influence the cost of a new product. Regarding costs, R&D expenses are only half the total cost of innovation and there is a trade-off in the cost of R&D and the time needed for the

total innovation process. Greater initial expenditures tend to shorten the lead time to market readiness. Mansfield also found that the largest corporations do not have significant advantages in the R&D area over somewhat smaller firms. In fact, the cost of speeding up an innovation seems to be positively related to firm size, and use of innovations tends to spread more rapidly in less concentrated industries. Mansfield recommends that private industries study carefully the economics of their R&D programs. Over-runs in commercial development are very large and projections of a project's success are inaccurate 30 percent of the time.

In testimony before the House of Representatives (13), Mansfield stated that from the available evidence there may be some underinvestment in civilian R&D. However, the available evidence is too sparse and too weak to indicate specifically where the shortfall, if it really exists, is greatest. The fact that an industry is unable to compete in foreign markets or is having trouble on other grounds does not indicate that there is justification for additional R&D. Thus, he recommends that any program designed to compensate for an underinvestment in R&D should be begun on a relatively small scale and expanded as evidence of its value is developed. No program should rely too heavily on centralized planning (the pluralistic system has served us well) or on tax incentives, which tend to induce more of the same kind of R&D presently being done. It may be advantageous to encourage additional R&D through federal contracts and grants to firms. The available evidence indicates also that public policy should try to eliminate unnecessary barriers to market entry and to promote competition in American industry.

1972/1973

Paul Armer

Armer's concerns center around the social implications of computer technology and the problems created for the individual and his organization resulting from the rapid pace of change which renders the individual's skills obsolete long before he reaches retirement age.

With respect to the former, he has pointed out (1) that the chief reason for the tremendous impact of computers has been the continuously and rapidly declining cost of a unit of raw computing power. Such costs have been declining by a factor of ten approximately every four years. Computers are thus dramatically changing the economics of information storage and processing. It becomes economically feasible, for example, to collect and store large amounts of information about individuals, thereby threatening their privacy.

With respect to obsolescence, Armer has formulated what he calls the "Paul Principle" — in allusion to the recently expounded "Peter Principle" according to which individuals tend to rise in organizations

to their "level of incompetence." Armer hypothesizes that "individuals often become incompetent over time at a level at which they once performed well, because they become incompetent (obsolete) for that level." In (2) he suggests that one thing which can be done by professional societies to aid their members in staying current is to offer self-assessment tests which help the individual to discover what it is that he does not know.

William F. Baxter

In 1970 William F. Baxter gave a series of lectures at Stanford University's Alumni Summer College. He explained basic economic principles, and then described how these can be applied to understanding the complex issues of pollution control. Baxter has written a book based on these lectures. He shows that in order to make the operating level which maximizes profits for a given company be the same as that which has the optimum level of pollution from the standpoint of society, it is necessary to impose excise taxes on effluents and/or to bring class action suits against polluters. For example, to reduce airplane noise, we should require airports to make periodic payments to neighboring landowners in the amount by which the rental value has been diminished during the preceeding period. In an article published last year (3), Baxter details a system of taxes on effluents which would "cause the level of harm from pollution to fall until it was not more than that justifiable by the essentiality to the society of the product yielded by the activity."

John S. Chipman

In several papers, Chipman develops rigorous bases for some propositions underlying several economic theories. For example, the concept of "community indifference curves" as a tool or expository device for deriving market demand functions has a long history in the literature of international trade. Chipman proves that a sufficient condition under which such a concept is valid is that preferences between alternative patterns of consumption are independent of scale of income (homothetic) and incomes are proportional. This has several interesting applications in the pure theory of international trade.

At least from the time of John Stuart Mill, economists have speculated on whether a transfer of funds (e.g. a loan) from one country to another will worsen the terms of trade for the paying country so that an "excess burden" is involved. The classical presumption, stated by Mill, is that the excess burden exists. Chipman gives conditions in rigorous models of trade for this to occur (4). Even when the countries have no preference for their own goods over foreign goods there is a presumption of an excess burden. This is because countries tend to specialize in different export goods. Since the paying country has

less to spend, its resources tend to go into export industries whose outputs are increased, while in the receiving country, which has more to spend, resources are drawn out of the export industries whose outputs are reduced. These changes in production cause prices to move unfavorably for the paying country. Only if the countries produce the same lists of goods with the same kinds of productive techniques is it likely that the excess burden can be avoided.

Turning to domestic economics, Chipman and James Moore of Purdue University look at the "New Welfare Economics," which is an attempt to make welfare prescriptions without having to make value judgments. Chipman shows that the New Welfare Economics cannot escape the possibility of giving rise to an inconsistent sequence of policy recommendations, unless either the distribution of income and wealth is assumed to be suitably restricted or individual preferences are assumed to be identical and homothetic. In general, we cannot make policy recommendations except on the basis of value judgments, and these should be made explicit.

Victor R. Fuchs*

Fuchs applies economic principles to the health field in considering problems of the current high cost of medical care, limited access to physicians, and mounting health problems such as the increase in heart disease. First, he points out that the most important influences on health today are genetic factors, environment and life style, not quality and availability of health care. For example, in the United States, death rates for adult males have actually been rising slowly since 1960 although health care has generally improved.

Economics cannot directly affect these important influences on health and mortality, but it can clarify the problems involved in how to allocate scarce resources so as to best satisfy human wants, including the desire for access to good medical care (5). No country is as healthy as it could be because of other social goals such as justice, transportation, beauty and education. Due to the scarcity of resources we must choose between health and other goals; we must also make choices within the health field. The economist determines the best choices by applying the rule of "equality at the margin" — relating the incremental yield of any particular program to the incremental cost of the program, and allocating resources so that the yield per dollar at the margin is the same for all programs. Fuchs suggests the following overall plan to improve health and medical care:

- Establishment of compulsory, universal, comprehensive health insurance.
- Establishment of more Health Maintenance Organizations which

*Fuchs' work was partially supported by the Carnegie Corporation.

provide comprehensive medical care to a voluntarily enrolled consumer population. (Although coverage is compulsory, choice of plan is voluntary.) Fees are fixed and prepaid.

- Elimination of many of the restrictions on health manpower so as to promote increased utilization of physician extender personnel, thereby improving patient access to primary care.

In a forthcoming book, Fuchs concludes by suggesting that equalizing the availability and quality of health care should be a step toward a more egalitarian society.

Donald Kennedy

In Section V, it was mentioned that some Fellows utilize their year at the Center to move from the specific discipline in which they have been working toward the multi-disciplinary problems of science, technology and society. Donald Kennedy, a biologist, is an example of this. One of the main purposes of his coming to the Center was to pursue an interest in the problems of science and society. In particular, he had accepted a commitment to chair a National Academy of Sciences committee evaluating alternative strategies of pest control in public health and agriculture. As a Fellow at the Center, Kennedy was able to devote considerable time to reading and preparation for his committee activities and to consultations with other Fellows (especially in Economics and Law) about various aspects of the problem: technology assessment, institutional incentives to improve technology, diffusion of technology, the economics of innovations and other issues. The fruits of his fellowship will thus appear somewhat later than for the average Fellow.

John R. Platt

Platt is chiefly concerned with the social changes needed for man to accommodate to the modern world. He believes that the human race is now passing through the greatest transformation in history. Technological advances are astonishing; energy resources are now reaching their limits. Consequently, society's attitudes, ethics and institutions are rapidly changing, and must change even more.

Man must adapt from a growth society to a global steady state society. Jonas Salk has pointed out that our situation in the world today can be compared to the growth of a colony of bacteria. The size of the colony grows geometrically until it reaches the limits of its food supply. Then it either levels off so that there is a "steady state," or the colony dies out completely. To avoid catastrophe, our society must now learn to live in such a steady state. Platt has published eight articles (14 through 21) describing the current situation and what must be done about it.

An obstacle to society's adjusting to a steady state is the social trap. A "social trap" is created when an individual or organization

takes off in some direction or becomes enmeshed in some set of relationships which, should it later prove to be harmful or undesirable, seems impossible or too costly to back out of or abandon. The traps of "individual goods and collective bads," such as individual countries stockpiling nuclear bombs to the detriment of world safety, cause many of the current social and political difficulties. These traps could be changed or avoided by a change in the associated reinforcements. For example, the establishment of a superordinate regulating mechanism, the Sherman Anti-Trust Act, reinforced the short term advantage for companies to avoid monopolies. Nested traps, in which behavior detrimental to the general good is perpetuated by several interrelated reinforcements, are the most difficult to change. They should be analyzed extensively to determine effective counter-reinforcements.

Platt suggests several such counter-reinforcements. Television should become more educational, physical and biological knowledge should be used increasingly to make efficient use of resources, education should be socially enhanced (particularly in the area of ecology) and simple living should be encouraged. Most importantly, new organizations with global networks of communication should be developed, creating a new breed of men and women with global allegiance. The ecology movement and the human potential movement may be harbingers of such organizations.

Fredrick C. Redlich

Like Kennedy, Redlich is an example of a scholar established in one discipline moving out into the multi-disciplinary problems at the interface between science, technology and society. A psychiatrist, Redlich developed a concern with the problems of medical ethics and accepted the chairmanship of a committee on Human Values in Health for the Institute of Medicine. His fellowship permitted him to learn about medical ethics and so far he has published two articles on the subject, (22) and (23). The first of these deals mainly with the ethical aspects of research conducted by an observer who conceals his identity from the subjects, and the second concerns professional values and conduct in the medical field as a whole. Redlich stresses that as medical technology improves and as the consumer becomes more informed, medical ethics will be reevaluated and social scientists ought to figure prominently in this assessment.

Israel Scheffler

Scheffler analytically examined several areas of philosophy while at the Center. In a published article (24) he analyzed Thomas Kuhn's influential book, the *Structure of Scientific Revolutions*. Kuhn had postulated that a scientific advance is made not in gradual, rational steps, but that it occurs in the scientist's mind as a total, sudden reorganization of thought, a "gestalt switch." Scheffler questions this.

First, he points out that Kuhn introduced the terms "vision" (a gestalt reorganization) and "revolution" (the result of a gestalt change) to replace "interpretation" and "deliberation" of science. According to Kuhn, competition of theories is visualized as combat, with victory the prize. Scheffler shows that to reduce the combat of revolutionary parties to a gestalt switch is to leave out the critical aspects of advocacy and opposed loyalties; it is to omit the notion of claim and that of rationale. Whereas, conversely, to offer the gestalt switch as a case of revolutionary transition is to import the inapplicable concepts of advocacy, commitment and party combat to merely phenomenally alternative perceptual configurations. If we apply such a hybrid notion to the case of scientific theory change, we are led to develop a view that emphasizes the intuitive and spontaneous shift of thought and leaves no room for deliberation or interpretation, but demands commitment.

Vernon L. Smith

Smith conducted an economic analysis of the optimum level of recycling in relation to disposal. In a published article (25), he viewed the problem of waste accumulation as the joint result of household and firm decisions to let waste degrade instead of recycling it into production. In a decentralized competitive society, no market will exist to reflect the social cost of public pollution. Smith recommends applying a system of "user" charges to redirect resources in accordance with the reality of such public costs.

Smith reaches similar conclusions in a forthcoming book on the economics of natural and environmental resources. For example, in one chapter he studies the best use of land allocated for recreation. Visitor use of the National Parks is increasing, resulting in distress for naturalists and environmentalists, and for National Park and Service administrators caught in the cross currents of political pressure to make public lands freely available to the citizenry while attempting to maintain these lands in their natural state. Past studies have concentrated on conservation versus development. But there are also the problems of managing, developing and rationing the resources already allocated to recreational uses. Smith concludes in this chapter that rationing use by deliberately increasing the cost of scenic resources may be society's best option.

The best way to increase cost is to increase (or not decrease) the difficulty of access. For example, if a road is *not* built through a primitive forest, only those hardy enough and with strong enough preferences will use the area. By leaving the natural resources in their original state of high-cost access, the administrative cost of overlaying direct controls will be avoided, and yet use of the areas will be rationed. Such rationing devices, Smith says, "... not only reduce

crowding, and ecosystem damage; they also restrict use to those whose preferences are strong enough to overcome substantial cost of interacting, and in this sense, the scarce resource is allocated to its more valued uses."

Lefton S. Stavrianos

Stavrianos is optimistic about the future. When viewed in the light of historical perspective, all the current social unrest can be seen as the birth pangs of a new epoch as well as the death agonies of the old order. In a forthcoming book, Stavrianos pursues this theme by looking at major historical changes, such as the agricultural and industrial revolutions. He states that because the scientific revolution is now producing sufficient abundance to free men from subsistence activities, mass expectation and assertiveness are arising to create what may be called the "Participatory Revolution," most clearly seen in the movements of workers, youth, women and minorities. In the future, Stavrianos predicts, there will be no dominating power, but a world "moulded by interaction and adaptability . . . ". Stavrianos sees our present problems as rising from the social context of science rather than from science itself. Thus, we need to conceive and implement the social engineering made necessary by the scientific revolution. He believes that each scientific breakthrough has had (and will have in the future) a corresponding breakthrough in mass assertiveness and participation which produces the pressure necessary for the appropriate social change.

Joseph Weizenbaum, Israel Scheffler, Paul Armer, Terrance Sandalow, Donald Kennedy, John R. Platt and others — *The Scope and Limitations of Artificial Intelligence*

There are some who believe that "the brain is merely a meat machine" and that when a few technical problems are solved, the computer not only will have all the capabilities of the human brain but will exceed it. Research intended to produce intelligent behavior from computers is usually referred to as work in artificial intelligence. Weizenbaum has been concerned with the question of just how "intelligent" machines may become and what this means to society. His fellowship was devoted to the beginnings of a book which will probably represent the only tangible output from the group effort.

The concerns of Weizenbaum and the others resulted in a series of seminars and discussions which were the dominant thread of activity at the Center during 1972-1973. The seminar series arose spontaneously from conversations which the Center's culture and setting made possible. The original discussants (Weizenbaum—computer science, Israel Scheffler—philosophy) announced to the other Fellows their new-found common interests and invited others to join. Beginning

with the role of analogy and metaphor in understanding and explaining, and thus the role of language in understanding our world, the subject matter expanded to include the role of formal models (especially computational or cybernetic ones) and the biological, perceptual and brain mechanisms underlying our use of language. Weizenbaum and Sandalow also examined judicial decision making and how a computer might (or might not) make such decisions.

Where science stands with respect to understanding the human brain is obviously crucial to considerations of when and to what extent computer models of brain behavior will be possible. With this in mind, activity on this topic reached its peak in mid-May when a two-day conference was held on "New Models of Brain and Behavior." About half the participants were individuals from institutions other than the Center.

Weizenbaum believes that the essence of an organism is defined by the problems with which it must cope. The problems humans face, problems which are the very determinants of their humanity, cannot logically be problems with which a machine is confronted. For example, only humans can be confronted with the problems that tormented Faust or Hamlet. No matter how "intelligent" we may be able to make machines in the future, their "intelligence" will be an alien one.

VIII. PUBLICATIONS

Some scholars bring to the Center completed research and use their time here to write the results of it. Others begin to work in different areas or find new directions for their research. Consequently, the lead times between fellowships and their tangible results vary considerably. The following is a list of those books and articles which have been published to date:

1. ARMER, PAUL. "Computers in Society." *Proceedings of the Third National Conference of the New Zealand Computer Society*, Vol. III, 1972.
2. _____. "Obsolescence and Self-Assessment." *Proceedings of the 1972 Conference of the Special Interest Group on Computer Personnel Research (SIGCPR)*, Association for Computing Machinery, New York, New York, 1972.
3. BAXTER, WILLIAM F. "International Implications of an Effluent Tax System: Some Preliminary Observations." *Stanford Journal of International Studies*, Vol. VIII, Spring, 1973, 1-15.
4. CHIPMAN, JOHN S. "The Transfer Problem Once Again." *Trade, Stability, and Macroeconomics: Essays in Honor of Lloyd A. Metzler*. Editors: George Horwich and Paul A. Samuelson. New York: Academic Press, 1974, 19-78.
5. FUCHS, VICTOR. "Why Health Economics?" George James Memorial Issue of the *Mount Sinai Journal of Medicine*, Vol. 40, No. 4, July/August, 1973, 569-575.
6. JONES, CHARLES O. "Air Pollution and Contemporary Environmental Politics." *Growth and Change*. July, 1973, 22-27.
7. _____. "From Gold to Garbage: A Bibliographical Essay on Politics and the Environment." *The American Political Science Review*, Vol. 66, June, 1972, 588-595.

8. _____. "The Limits of Public Support: Air Pollution Agency Development." *Public Administration Review*, Vol. 32, September/October, 1973, 502-508.
9. LEDERBERG, JOSHUA. "Biological Innovation and Genetic Intervention." *Challenging Biological Problems*, John A. Behnke, Editor. Oxford University Press, New York, 1972, 7-28.
10. _____. "The Control of Chemical and Biological Weapons." *Stanford Journal of International Studies*, Vol. VII, Spring, 1972, 22-44.
11. _____. "The Freedoms and the Control of Science: Notes from the Ivory Tower." *Southern California Law Review*, Vol. 45, No. 2, 1972, 596-614.
12. _____. "The Genetics of Human Nature." *Social Research*, Vol. 40, No. 3, Autumn, 1973, 375-405.
13. MANSFIELD, EDWIN. *Science, Technology and Society*, Hearings before the Sub-committee on Science, Research, and Development of the Committee on Science and Astronautics of the House of Representatives, April 13, 1972, 97-126.
14. PLATT, JOHN. "Beliefs that Can Link Men Together." *Zygon*. May, 1974.
15. _____. "Can Determinism and Freedom Be Reconciled?" *Teilhard Review*, Vol. 8, Spring, 1974.
16. _____. "Convergence and the Future." *Teilhard Review*, Vol. 8, Spring, 1974.
17. _____. "Love and Consciousness." *Teilhard Review*, Vol. 8, Spring, 1974.
18. _____. "Movement for Survival." *Science*, Vol. 180, May 11, 1973, 580-582.
19. _____. "Reading the Signs and Portents." *Courses by Newspaper* (published by the National Endowment for Humanities). October 22, 1973, 45-49.
20. _____. "Science for Human Survival." *Science Teacher*, Vol. 40, No. 1, January, 1973, 11-13.
21. _____. "Social Traps." *American Psychologist*, Vol. 28, August, 1973, 641-651.
22. REDLICH, FREDRICK. "Ethical Aspects of Clinical Observations of Behavior," *Journal of Nervous and Mental Disease*, Vol. 157, No. 5, 1973, 313-319.
23. _____. "What is Medical Ethics?" *Connecticut Medicine*, Vol. 37, No. 11, November, 1973, 577-582
24. SCHEFFLER, ISRAEL. "Vision and Revolution: A Postscript on Kuhn," *Philosophy of Science*, Vol. 39, No. 3, September, 1972, 366-374.
25. SMITH, VERNON L. "Dynamics of Waste Accumulation: Disposal vs. Recycling," *The Quarterly Journal of Economics*, Vol. 86, No. 345, November, 1973, 600-616.

IX. PRESENTATIONS

1971/1972

Charles O. Jones

"Federal—State—Local Sharing of Authority in Air Pollution Control," presented at the 64th Annual Meeting, Air Pollution Control Association, Atlantic City, New Jersey, June 29, 1971.

"Federal Air Pollution Policy: Some Thoughts on Effects and Feedback," presented at the Conference on the Measurement of Policy Impact, Florida State University, May 6-8, 1971.

Joshua Lederberg

"Biological Innovation and Genetic Intervention," presented to the Jubilee Symposium of Hoffman-La Roche Company, Ltd. held at Basil, Switzerland, September, 1971.

Edwin Mansfield

"Production and Application of New Industrial Technology," presented at meetings of the Southern Economic Association at Miami Beach, 1971.

"Science, Technology and Society," hearings before the Subcommittee on Science, Research and Development of the Committee on Science and Astronautics of the House of Representatives, April 13, 1972.

"Technological Forecasting," presented at the 1972 meeting of the International Economic Association in Moscow, 1972.

1972/1973

Paul Armer

"Complexity and Communication," a seminar at the Fall Joint Computer Conference of the American Federation of Information Processing Societies, Anaheim, California; December 4, 1972.

"Computers and Society," a seminar at the School of Law, Stanford University, February 14, 1973.

"Computers and Society," a talk presented to the New Zealand National Computer Conference, Massey University, Palmerston North, New Zealand, August 16-19, 1972.

"Impact of the Computer on Individual Life," a talk presented at the Second International Conference on Man and Computer of the Institute de la Vie, Bordeaux, France, September 11-16, 1972.

"Obsolescence and Self-Assessment," a talk presented to the Association for Computing Machinery, San Francisco, California, November 16, 1972.

"Professional and Institutional Obsolescence," a talk presented to the Journalism Fellows, Department of Communications, Stanford University, January 21, 1973.

"Self-Assessment Techniques," a talk presented to the Engineering Foundation Conference on "Maintaining Professional and Technical Competence of the Older Engineer-Engineering and Psychological Aspects," Berwick Academy, South Berwick, Maine, July 1-6, 1973.

"Technical Obsolescence," a talk presented to the 4th Annual ADP Symposium, Mechanicsburg, Pennsylvania, November 28, 1972.

"Technological Obsolescence" and "Social Implications of Computers," two seminars presented at Columbia University, New York, November 30 and December 1, 1973.

William F. Baxter

"Government Intervention in the Chemical Industry in the Next Decade," meeting of the Chemical Industry Executives, Columbia, Maryland, May, 1973.

"Prospects for Regulatory Change in the 1970's;" Stanford Graduate School of Business, June, 1973.

John S. Chipman

"When Does an Increase in National Income Imply an Increase in National Welfare?", Western Management Science Institute, Interdisciplinary Colloquium for Mathematics in the Behavioral Sciences, University of California at Los Angeles, January 19, 1973.

"The Transfer Problem Once Again," Food Research Institute, Stanford University, March 2, 1973.

"Robustness of Least Squares Estimation of Linear Trend when Residuals are Autocorrelated," Statistics Department Colloquium, Stanford University, March 13, 1973.

"When Does an Increase in National Income Imply an Increase in Potential Welfare?", Berkeley-Stanford-CASBS Seminar in Economic Theory and Econometrics, Stanford University, April 5, 1973.

"The End of the New Welfare Economics," All Department Seminar, Stanford University, May 15, 1973.

"A Reconsideration of the Elasticity Models of Balance of Payments Adjustment," Seminar in Economic Development, Monetary Theory and Institutions, and International Trade, Department of Economics, Stanford University, May 17, 1973.

"The Paretian Heritage," Opening Lecture to commemorate the fiftieth anniversary of Pareto's death, Canadian Economic Association, Kingston, Ontario, Canada, June 1, 1973.

"A Renewal Model of Economic Growth: The Continuous Case," Institute for Mathematical Studies in the Social Sciences, Stanford University, July 18, 1973.

Victor R. Fuchs

"Marriage, Family Human Capital, and Fertility," NBER — Population Council, Chicago, Illinois.

"Hospital Regulation," Harvard University Center for Community Health and Medical Care, Cambridge, Massachusetts.

"Some Economic Aspects of Mortality in Developed Countries," presented at the International Economic Association Conference on Economics of Health and Medical Care, Tokyo; April 2-7, 1973.

Seminars on various aspects of health economics were given at the following institutions:

University of California Medical School in San Francisco
Palo Alto Medical Care Foundation
Stanford Economics Department
The Mayo Clinic
University of Minnesota Economics Department
San Francisco Bay Area Health Care Society
College of Physicians of Northern California
University of California, Berkeley, Economics Department
Stanford Hospital, Department of Medicine

Donald Kennedy

"Alternative Strategies of Pest Control in Public Health and Agriculture," Chairman of a National Academy of Sciences Committee on this topic.

John R. Platt

"Science for Human Survival," presented at:

Program on Science and Society, University of Edinburgh, England, January 30, 1973.

National Teachers Association, New Orleans, Louisiana, November 9, 1972.

Liebig Lecture, Phi Lambda Upsilon Honorary Chemical Fraternity, University of Colorado, Boulder, Colorado, April 3, 1973.

"Social Traps," presented at:

Divisional Lecture, University of California, Santa Cruz, December 5, 1972.

Department of Psychology Colloquium, University of California, Santa Barbara, March 8, 1973.

"Convergence and the Future," presented at the Teilhard Center for the Future of Man, 7th Annual Conference, October 20-21, 1972.

Fredrick Redlich

"Problems of Medical Ethics," seminar at the Center for Advanced Study in the Behavioral Sciences, 1972.

"Psychoanalysis and the Medical Model," meeting at the Academy for Psychoanalysis, Honolulu, May, 1973.

"What is Medical Ethics?", AMA Conference on Medical Ethics, Washington, D.C., April, 1973.

Lefton Stavrianos

"Aspects of Contemporary History," Fresno State University, Fresno, California, 1972.

"For the First Time in 6000 Years," University of California, San Diego; and University of California, Santa Barbara, 1972.

"Technology and Marlow's Ladder—Is Technology a Pandora's Box or an Aladdin's Lamp?", Center for Advanced Study in the Behavioral Sciences, Stanford, California, 1972.

Joseph Weizenbaum

"The Compulsive Programmer," Computer Science Colloquium, Stanford University, Stanford, California, December 5, 1972.

"Computer Networks and Their Implications," IEEE Convention, Washington, D.C., October 24, 1972.

"The Coming National Metaphor & Urban Planning," School of Urban Design, University of California, Los Angeles, March 8, 1973.

"The Limits of Artificial Intelligence," University of California, Santa Cruz, April 24, 1973.

"Rationality and Explication in Computer Models," Sociology Department, University of California, Berkeley, April 26, 1973.

"The Responsibilities of the Computer Scientist," Stanford Computer Science Lecture Section, Stanford University, Stanford, California, December 8, 1972.

"The Scope and Limits of Artificial Intelligence," University of California, Berkeley, Lecture Series, February 6, 1973.

"What about Artificial Intelligence—a Debate," Computer Science Colloquium, University of California, Berkeley, January 16, 1973.

Panel Member—Conference on Computers, Society and Legal Education: Stanford University Law School, June 24-27, 1973.